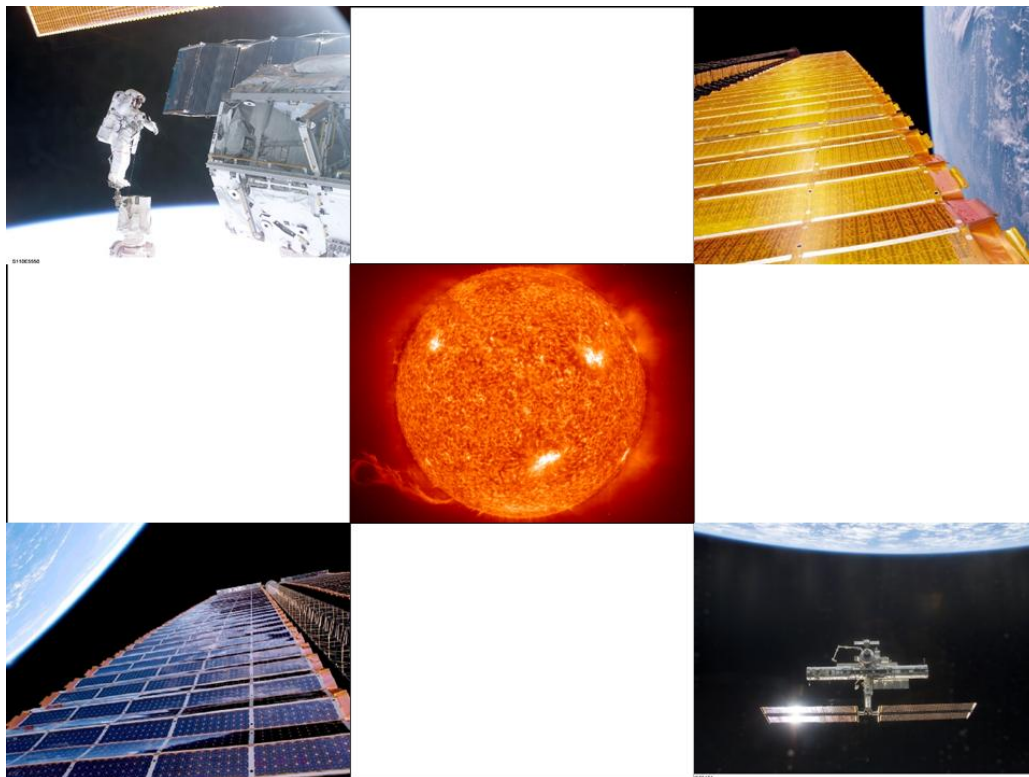




Solar Energy: It's Importance to Earth and Space Exploration

A Digital Learning Network Experience

Designed To Share



The Vision for Space Exploration

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A Digital Learning Network Experience



**National Aeronautics and
Space Administration**

Designed To Share

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Digital Learning Network (DLN) Expedition

A DLN Expedition is a one time connection that allows students to experience NASA first-hand. Each expedition features an integrated educational package of grade-appropriate instruction and activities centered on a 50 minute videoconference. Students participate in a Question and Answer session with a NASA JSC education specialist or a NASA Subject Matter Expert.

The sequence for a DLN Expedition includes:

- Students complete vocabulary and Pre-Classroom Activity
- A one time DLN videoconference connection with in-formal student participation.
- Complete Post-Activity Assessment and complete online evaluation for teacher and students.



Expedition Overview

Grade Level K-4

Focus Question

Why would solar energy be an important source of energy in space and on Earth?

Instructional Objectives

Students will understand the importance of energy.

Students will discuss the historical foundations of energy and its production.

Students will understand the two types: kinetic and potential energy.

Students will understand how NASA utilizes the sun and solar cells to run missions.

National Standards

National Science Education Standards (NSES)

Science as Inquiry – Content Standard A

Physical Science – Content Standard B

Life Science – Content Standard C

Earth and Space Science – Content Standard D

Science and Technology – Content Standard E

Science in Personal and Social Perspectives – Content Standard F

History and Nature of Science – Content Standard G

National Council of Teachers of Mathematics (NCTM)

Standard 4 – Measurement Standard 8 – Communication

International Technology Education Association (ITEA)

Design – Standard 10

The Designed World – Standard 17

Texas State Standards

5.8 Science Concepts – Standard B

6.9 Science Concepts – Standard B

8.2 Science Processes – Standards A, C

SEQUENCE OF EVENTS

Pre-Conference Requirements

Online Pre-assessment A pre-assessment tool is available to determine the students' level of understanding prior to the videoconference. Suggested answers are included.

Expedition Videoconference

Expedition Videoconference (About 45-60 minute conference)

Travel through time as we see how solar energy was used in the past, how it is used today, and how it could be used in the future. Learn about the various forms of energy and how it is being used at NASA for missions in space. See first hand how solar cells work and how they are used to power the ISS and the rovers on Mars.

Post-Conference Requirements

Online Post-assessment

A post-assessment tool is available to determine changes in student levels of understanding.

NASA Education Evaluation Information System (NEEIS) Feedback Forms

Educator and student feedback forms are available online for all DLN events.

Post-Conference Requirements

Online Post-assessment

A post-assessment tool is available to determine changes in student levels of understanding.

NASA Education Evaluation Information System (NEEIS) Feedback Forms

Educator and student feedback forms are available online for all DLN events.



National Standards

National Science Education Standards (NSES)

National Education Standards <i>Science</i>	Potential or Kinetic?	Angles and Electricity	Chain Reaction
<u>Content Standard A: Science as Inquiry</u>			
Abilities Necessary to do Scientific Inquiry	X	X	X
Understanding About Scientific Inquiry	X	X	X
<u>Content Standard B: Physical Science</u>			
(K-4) Position and Motion of Objects	X		
(5-8) Transfer of Energy		X	
(9-12) Chemical Reactions			X
(9-12) Conservation of Energy and Increase in Disorder			X
<u>Content Standard C: Life Science</u>			
Regulation and Behavior			
<u>Content D: Earth and Space Science</u>			
Earth in the Solar System			
<u>Content Standard E: Science and Technology</u>			
Abilities of Technological Design	X	X	X
Understandings About Science and Technology	X	X	X
<u>Content Standard F: Science in Personal and Social Perspectives</u>			
Natural Hazards			
Risks and Benefits			
<u>Content Standard G: History and Nature of Science</u>			
Science as a Human Endeavor			



Texas Essential Knowledge and Skills

Texas Essential Knowledge and Skills

Texas Science Essential Knowledge and Skills TAKS Objectives <i>Science</i>	Potential or Kinetic?	Angles and Electricity	Chain Reaction
<u>Objective 1: The student will demonstrate an understanding of the nature of science</u>			
Scientific processes	X	X	X
<u>Objective 2: The student will demonstrate an understanding of the life sciences</u>			
Scientific concepts	X	X	X
<u>Objective 3: the student will demonstrate an understanding of the physical sciences</u>			
Scientific concepts: the student knows that complex interactions occur between matter and energy	X	X	X
Scientific concepts: the student knows that energy comes in many different forms	X	X	X
<u>Objective 4: The students will demonstrate an understanding of the earth sciences</u>			
Scientific concepts	X	X	X



Pre-Conference Requirements

Pre-Assessment

A week before the event, students will need to take the pre-conference assessment. This short assessment will provide useful background information for the presenters to prepare for the videoconference.

Pre-Conference Assessment Questions

- 1. Where do we get solar energy?**
- 2. What is energy?**
- 3. Who is Sir Isaac Newton?**
- 4. What are the two types of energy?**
- 5. How is light related to energy from the sun?**
- 6. Why would solar energy be important to NASA?**
- 7. How is solar energy used on Earth?**



Pre-Conference Requirements

**Teacher's Page with suggested answers:
Answers to Pre and Post Assessment Questions**

- 1. Where do we get solar energy?** The Sun
- 2. What is energy?** Energy is strength or power to work or be active; force; vigor; the power of certain forces of nature to do work
- 3. Who is Sir Isaac Newton?** Scientist who was the first to argue that light energy was not waves but in particles.
- 4. What are the two types of energy?** Potential and Kinetic energy
- 5. How is light related to energy from the sun?** Light is absorbed by solar cells, which convert it to electricity.
- 6. Why would energy sources be important to NASA?** It provides a means for us to power the ISS, our rovers on Mars, and possibly future missions into space.
- 7. How is solar energy used on Earth?** As renewable energy to power homes, cars, and buildings. Future uses are endless as technology advances.



Expedition Videoconference Guidelines

Audience Guidelines

Teachers, please review the following points with your students prior to the event:

- Videoconference is a two-way event. Students and NASA presenters can see and hear one another.
- Students are sometimes initially shy about responding to questions during a distance learning session. Explain to the students that this is an interactive medium and we encourage questions.
- Students should speak in a loud, clear voice. If a microphone is placed in a central location instruct the students to walk up and speak into the microphone.
- Teacher(s) should moderate students' questions and answers.

Teacher Event Checklist

Date Completed	Pre-Conference Requirements
	1. Print a copy of the module.
	2. Have the students complete the pre-assessment.
	3. Email questions for the presenter. This will help focus the presentation on the groups' specific needs.
	4. Review the Audience Guidelines, which can be found in the previous section.
	Day of the Conference Requirements
	1. The students are encouraged to ask the NASA presenter qualifying questions about the Expedition.
	2. Follow up questions can be continued after the conference through e-mail.
	Post - Conference Requirements
	1. Have the students take the Post-Assessment to demonstrate their knowledge of the subject.
	2. Use the provided rubric as guidelines for content and presentation criteria.
	3. Teacher(s) and students fill out the event feedback.



Expedition Videoconference Outline

Introduction to Expedition Videoconference

Travel through time as we see how solar energy was used in the past, how it is used today, and how it could be used in the future. Learn about the various forms of energy and how it is being used at NASA for missions in space. See first hand how solar cells work and how they are used to power the ISS and the rovers on Mars.

Outline for Video Conference

- I. Welcome**
- II. Introduction**
- III. Historical Foundations of Energy**
- IV. Understanding Forms of Energy**
- V. NASA Energy Aboard ISS**
- VI. Solar Cells Demonstration**
- VII. Future Uses of Energy**
- VIII. Careers/Website**
- IX. Q&A**
- X. Good-Bye**



Pre-Classroom Activities



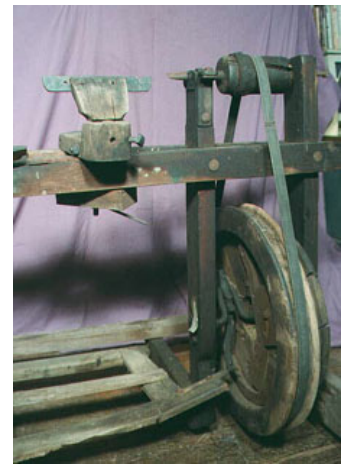
Activity: Potential or Kinetic

Article: Reinventing the Wheel

The wheel was one of the first things man made. At first, wheels were used to move big things. It took a while to learn to use a wheel to make power. One way to do this is a flywheel. It changes energy and makes machines work. Scientists have made an even better flywheel. It is strong enough to be used by NASA!

Today, we use batteries to get most of the power we need. But, flywheels are still used. Artists use a potter's wheel to work with clay. Gears move clock hands. These are both flywheels. Think of a toy top spinning on a table. Flywheels work a lot like that.

Flywheels make electricity. It is saved until it is needed. Batteries work the same way. But, flywheels are better. They don't have acids in them. Getting hot and then cold doesn't hurt them. But, it can ruin a battery. Flywheels used to be slow. Now, they move faster, so they make more power. They can be used by hospitals and factories. They might even run cars someday!



Right now, the Station gets its power from solar arrays. They use sunlight to make electricity. Cells aim at the Sun. They catch all the light they can. This charges the Station's batteries, too. The Station uses batteries when it is in the Sun's shade. It doesn't take long for the batteries to wear out. New ones have to be sent. This costs lots of money. NASA wants to use flywheels for power. Flywheels won't wear out. They can make more power than batteries. They will save NASA time and money!

Courtesy of NASA's Aeronautics Mission Directorate

Potential or Kinetic?

Teacher Sheet(s)

Objective: To distinguish between potential and kinetic energy.

Level: K-4

Subjects(s): Science, Technology

Prep Time: Less than 10 minutes

Duration: One class period

Materials Category: General classroom

National Standards:

Science: 3c

Math:

Technology (ISTE):

Technology (ITEA): 16a

Materials:

- Student sheets

Related Links: *(none)*

Supporting Article:

Reinventing the Wheel

Pre-Lesson Instruction:

- Duplicate the Student Sheets.

Background Information:

Flywheels are wheels on a revolving shaft, used to regulate machinery or accumulate power. They store kinetic (potential) energy within a rapidly spinning wheel, rotor, or disk and transfer it for use when needed. In a way, they're like a non-chemical battery with a few extra advantages. Flywheels contain no acids or other hazardous materials, and they're not affected by temperature extremes the way many batteries are. Typically, flywheels have been large steel wheels, rotating at low speeds. New materials and techniques such as high-strength composites, permanent magnets, and power electronics now make it possible to use a more modern flywheel to store energy for electrical applications. Newer flywheels use a generator to spin the rotor and to convert the kinetic energy to electrical energy.

Today, flywheels provide backup power for hospitals and manufacturing plants. Flywheels are being considered for use in hybrid electric vehicles, too.

Guidelines:

1. Read the article "Reinventing the Wheel" to the class.
2. Discuss the reasons flywheels are being developed for use by NASA.
3. Discuss energy. You have heard of the word "energy" all your life. You eat to grow and have "energy." You go to bed early so you will have "energy" to go to school. Energy is having the power to do work. Energy is everywhere. We use it everyday. Two kinds of energy are kinetic and potential. Kinetic energy is the energy of motion. Potential energy is stored energy. A frog sitting on a lily pad is an example of potential energy. The frog leaping is an example of kinetic energy.
4. Talk about flywheels. Flywheels store energy until it is needed. They turn potential energy into kinetic energy.
5. Distribute the Student Sheets. Have students decide if the picture shows potential or kinetic energy.

Discussion/Wrap-up:







- Check the Student Sheets orally.

Extensions: *(none)*

Potential or Kinetic?

Student Sheet(s)

Circle the correct answer.

Potential 	Kinetic	Potential 	Kinetic
Potential 	Kinetic	Potential 	Kinetic
Potential 	Kinetic	Potential 	Kinetic



Post-Conference

Online Post-Assessment

After the event students will need to take the post-conference assessment. (These questions are the same questions used in the pre-assessment.) The short assessment will help us measure student learning and identify any changes that need to be made in future programs.

Post-Conference Assessment Questions

Grades K-4

1. What is the difference between kinetic and potential energy?
2. How do the solar arrays on the ISS collect energy?
3. How would the use of flywheels on the ISS be more efficient than batteries?



NASA Education Evaluation Information System (NEEIS)

Please complete an online evaluation form to provide feedback on the NASA Challenge.

Feedback from you and a few of your students would be appreciated.

<http://dln.nasa.gov/dln/content/feedback/>

National Aeronautics and Space Administration



NASA Digital Learning Network

presents

Certificate of Completion

to

for

Completing the Solar Energy: Transfer to
Conservation Expedition

Instructor

Date



Vocabulary

Guidance: any of various processes for guiding the path of a vehicle, especially a missile, by means of built-in equipment

Navigation: the guidance of ships or aircraft from place to place

Gyroscope: a device consisting of a spinning mass, typically a disk or wheel, mounted on a base so that its axis can turn freely in one or more directions and maintain its orientation regardless of any movement of the base

Attitude: the position of an aircraft or spacecraft determined by the relationship between its axes and a reference datum (as the horizon or a particular star) ; Of an aircraft in flight, the angle made by its axes with the relative airflow

Arrays: order; a regular and imposing arrangement

Masts: a pole that extends outward and holds the solar panels on the International Space Station; a vertical pole that extends from a ship to support its sails

Solar Energy: usable power derived from the Sun

Light Spectrum: a band of color formed when a beam of white light is spread (as by passage through a prism) so that its different wavelengths are arranged in order

Atmospheric: of, relating to, or occurring in the atmosphere

Photovoltaic: capable of producing a voltage when exposed to radiant energy, especially light

Energy: strength or power to work or be active; force; vigor; the power of certain forces of nature to do work

Heat Transfer: The transfer or exchange of [heat](#) by radiation, conduction, or convection within a substance and between the substance and its surroundings.

Wavelength: a measure of a light; the peak – to peak distance one vibration of an electromagnetic wave

Solar Cell: a type of generator that produces electricity whenever sunlight shines on it

Kinetic Energy: The energy that an object has by virtue of its motion.

Potential Energy: The energy that an object has by virtue of its position in a field.

Battery: a cell or connected group of cells that converts chemical energy into electrical energy by reversible chemical reactions and that may be recharged by passing a current through it in the direction opposite to that of its discharge—called also storage cell

Power: The rate at which work is done or energy is released.

Nuclear: Of or relating to atomic nuclei

Fission: the splitting of an atomic nucleus resulting in the release of large amounts of energy

Fusion: the joining together of atomic nuclei to form heavier nuclei resulting in the release of enormous quantities of energy

Atom: one of the tiny particles of which all things are made

Nucleus: The small concentration of protons and neutrons, positively charged, at the center of atoms. The nuclei of atoms are positively charged and contain by far most of their mass (all but about 0.05% or less). The existence of the nucleus was [deduced in 1911](#) by Ernest Rutherford, from experiments on the scattering of [alpha particles](#) by nuclei.

Neutron: A particle found in the nuclei of atoms, similar to a [proton](#) but with no electric charge. Among light nuclei (helium, carbon, nitrogen), the ones that are most stable contain equal numbers of protons and neutrons. In heavier elements, the most stable ones have majority of neutrons, growing with mass. Varieties of nuclei also exist ("isotopes") which have other ratios between their numbers of protons and neutrons, but when the departure from the "most stable ratio" becomes large, neutrons can convert to protons + electrons (or vice versa), producing one form of radioactivity.

Chain Reaction: A reaction in which some of the products initiate further reactions of the same kind allowing the reaction to become self-sustaining.

Energy Word Scramble

Name _____

Digital Learning Network

Date _____

Unscramble the words below:

1. YEGREN _____

2. TEHA FSNTARER _____

3. HWTGANVEEL _____

4. AROLS LELC _____

5. GTILH TRECSMPU _____

6. SATSM _____

7. YRSARA _____

8. UTITDATE _____

9. SMTAOCEIRHP _____

10. TPOVICALOHOT _____

11. AROLS YEGREN _____

12. ACENDGIU _____

13. VAGINOTINA _____

14. CPYOOGERS _____

15. CELAUNR _____

16. SNSOIF _____

17. EIICKNT _____

18. TABERYT _____

19. WEOPR _____

20. LNTTAIEOP _____

21. ISUOFN _____

22. MTOA _____

23. LNCUUSE _____

24. EOURTNN _____

25. IHANC TRACEOIN _____



Energy Vocabulary Word Scramble

Answers

1. YEGREN is Energy
2. TEHA FSNTARER is Heat Transfer
3. HWTGANVEEL is Wavelength
4. AROLS LELC is Solar Cell
5. GTILH TRECSMPU is Light Spectrum
6. SATSM is Masts
7. YRSARA is Arrays
8. UTITDATE is Attitude
9. SMTAOCEIRHP is Atmospheric
10. TPOVICALOHOT is Photovoltaic
11. AROLS YEGREN is Solar Energy
12. ACENDGIU is Guidance
13. VAGINOTINA is Navigation
14. CPYOOGERS is Gyroscope
15. CELAUNR is Nuclear
16. SNSOIF is Fission
17. EIICKNT is Kinetic
18. TABERYT is Battery
19. WEOPR is Power
20. LNTTAEOP is Potential
21. ISUOFN is Fusion
22. MTOA is Atom
23. LNCUUSE is Nucleus
24. EOURTNN is Neutron
25. IHANC TRACEOIN is Chain Reaction



Resources

NASA Kids

For activities, games, stories and more, visit this website specifically designed for kids that are interested in space and NASA.

<http://www.nasa.gov/audience/forkids/home/index.html>



Background Information

For other activities on Energy for Grades K-4 visit:

What Stores the Sun's Energy?

Students examine materials that store energy.

http://dln.nasa.gov/dln/admin/media/download.jsp?file_id=1259

Spinning Wheels

Students create a type of flywheel and practice using it.

http://dln.nasa.gov/dln/admin/media/download.jsp?file_id=1260

Magnetic Power

Students demonstrate that different magnets have different strengths and show how magnets become stronger when they are combined.

http://dln.nasa.gov/dln/admin/media/download.jsp?file_id=1261

Attract or Repel?

Students demonstrate how magnets repel and predict their attraction.

http://dln.nasa.gov/dln/admin/media/download.jsp?file_id=1262



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